

MODEL

PZ-70

HV DC Op Amp
Instruction Manual

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1. INCOMING INSPECTION

A. Visual

The PZ-70 High Voltage DC Op Amp has been packaged in a special carton designed to give maximum protection during shipment. If the outside of the shipping carton is damaged, notify your shipping department immediately. The shipping department may wish to notify the carrier at this point.

If the shipping carton is undamaged externally, the instrument should be removed from the carton. If any damage is evident visually or if any rattling can be heard when the PZ-70 is shaken lightly, notify your shipping department and Burleigh Instruments, Inc. immediately. It is advisable to save the special carton for future storage or transportation.

B. Electrical

Assuming that the instrument is in good condition visually, a preliminary check of its electrical operation should be made. This can be accomplished quite simply by plugging in the instrument, connecting the OUTPUT $\div$ 100 connector to an oscilloscope and checking to see that increasing the BIAS control fully clockwise increases the OUTPUT $\div$ 100 signal from 0 to +10 v. Should the PZ-70 fail this initial check, Burleigh Instruments, Inc. should be notified immediately.

C. Quality Control

It should be noted that the PZ-70 undergoes several stages of inspection, test and calibration before shipment, including a burn-in at elevated temperatures for seven days minimum. The instrument has undergone an exhaustive final test and calibration process prior to shipment. Problems can occur, however, and should a problem arise during the warranty period, Burleigh's policy is to repair any instruments within one week of receipt at the factory. Before returning any instrument for repair, please contact Burleigh for instructions.

2. DESCRIPTION

The PZ-70 High Voltage Op Amp is a high voltage, high current amplifier with a bandwidth extending from DC to 5 KHz. Output current is ≥ 20 ma and the unit has a slew rate of 5 v/ μ sec. It is specially designed for driving capacitive loads with no loss of stability or risk of damage to the circuitry. It is fully protected from overload by an opto-isolator circuit which clamps the output to zero if the output current exceeds 22 ma.

A front panel BIAS knob permits the output to be set anywhere over the 1000 v DC operating range. This allows the unit to be used as a high quality DC power supply. In the amplifier mode the PZ-70 can be used in open or closed loop control systems. The gain is variable from 0 to 200, making the PZ-70 compatible with most common signal sources.

The all solid state design, conservative choice of components, large double sided circuit board and careful construction all combine to make the PZ-70 a rugged versatile and easily serviceable laboratory instrument.

3. HOW TO USE THE PZ-70

A. Front and Rear Panel



Figure 1

Use of the PZ-70 is quite straightforward, and will be obvious by examining the front panel shown in Figure 1. The RANGE switch is used to select the BIAS voltage range of 0 - 500 v or 0 - 1000 v output. The main purpose of the RANGE switch is to give finer resolution of the BIAS control. In the center of the panel, are an LED and a pushbutton switch marked LIMIT and RESET respectively. If the output current exceeds 22 ma the output will be clamped to zero and the LIMIT LED will light. To return operation simply reduce the input level with the GAIN control and press RESET. The LIMIT LED should extinguish and normal operation resume. The GAIN control adjusts the gain from 0 to 200. The BIAS control will adjust the DC operating point from 0 - 1000 v or 0 - 500 v depending on the range selected. The INPUT and OUTPUT connectors are on the rear panel (Figure 1). The input connector is a standard BNC. Two outputs are provided, a standard BNC and a Viking Thorkom TKR-07 which mates with many Burleigh products such as Fabry-Perot Interferometers, PZT Aligner/Translators and Tunable Etalons. An OUTPUT $\div$ 100 signal on a BNC connector is also provided for monitoring purposes.

B. Operation

The maximum slew rate for a sine wave output can be determined by the simple formula $dv/dt = 2\pi f V_o \cos(2\pi ft)$ where V_o is the peak amplitude of the sine wave output of the PZ-70 and f is the driving frequency.

When driving piezoelectric devices, which are purely capacitive, the drive frequency may be limited by the maximum current output of the PZ-70. Piezoelectric devices typically have input capacitances of 5 to 50 nf. The maximum current drawn for a sine wave output is given by

$$I_{\max} = C 2\pi f V_o$$

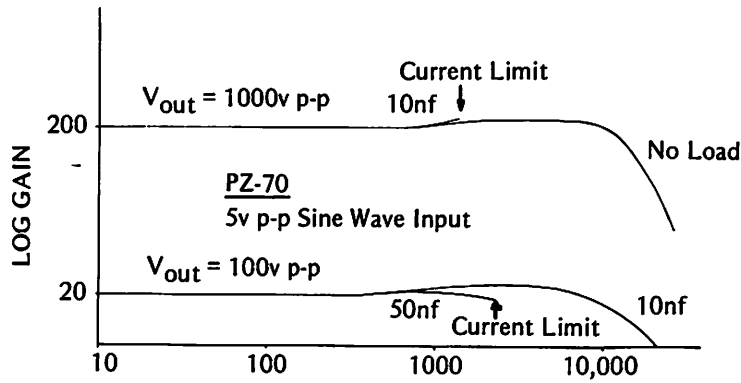


Figure 2

For small capacitive loads the gain of the PZ-70 is constant with a bandwidth exceeding 5 KHz as shown in Figure 2. As the capacitive load is increased the output voltage amplitude is limited by the current limit of the PZ-70 according to the above equation as shown graphically in Figure 3.

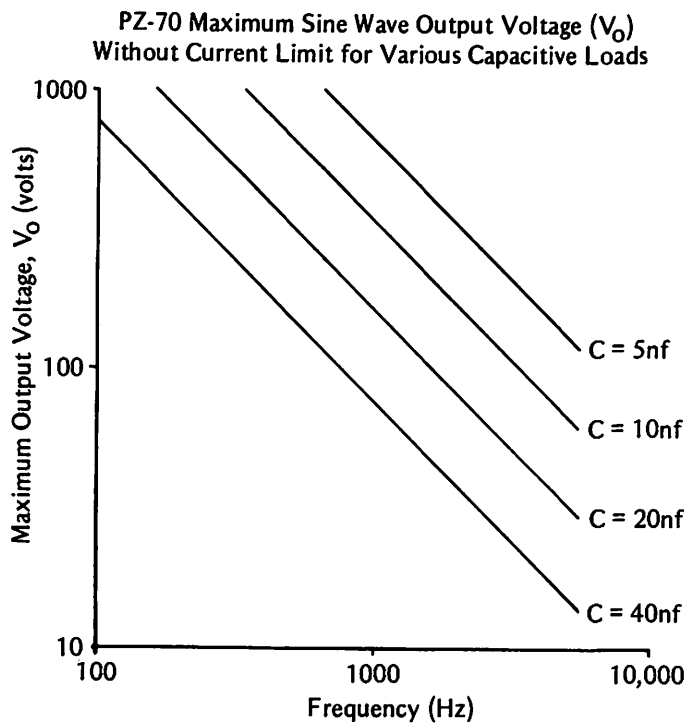


Figure 3

C. Applications

Figure 4 through 6 show the PZ-70 in several common modes of operation.

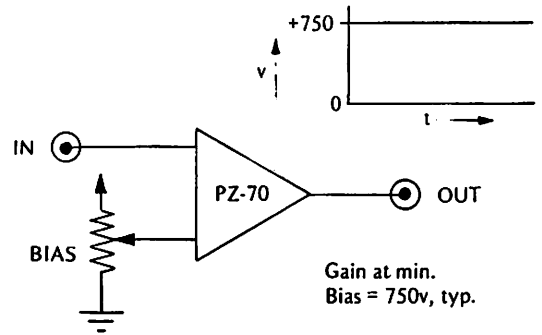


Figure 4
PZ-70 as HV Power Supply

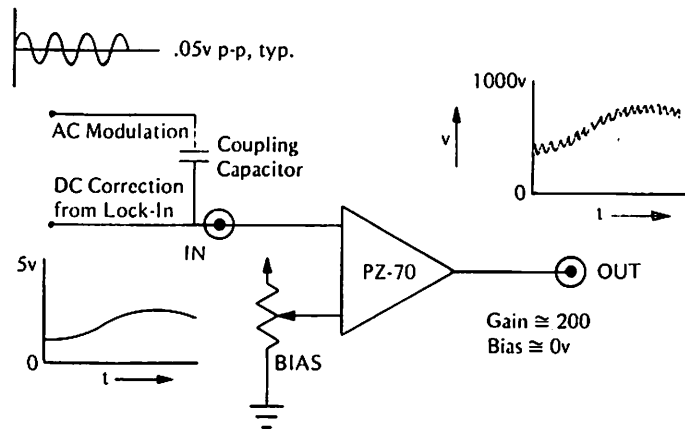


Figure 5
PZ-70 in Closed Loop Feedback System

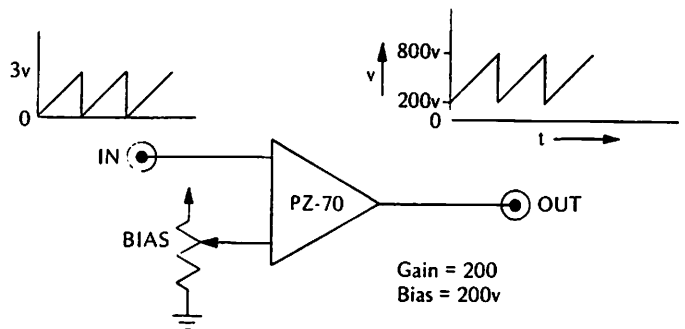


Figure 6
PZ-70 as HV DC Amplifier

$C = 30 \text{ nF}$ for z piezo stack

4. SERVICING

Servicing should be carried out only by skilled personnel who are thoroughly familiar with modern semiconductor circuitry. The integrated circuits used in this unit are especially delicate and may be destroyed by misapplication of test voltages. One is advised to study the pertinent circuit diagram until sure of how the unit performs before probing the circuit with test instruments. Most of the circuitry used here is relatively straightforward and its internal operation should be self-explanatory.

A. Circuit Description

1. Input Amplifiers

The input signal is attenuated by R52 and buffered by U3 which provides proper gain. DC bias is provided in a similar manner and buffered by U3.

2. Output Stage

U3 also provides a summing function for the input amplifiers. It drives a 2N3053 current booster which controls the outputs. This system is biased at a negative voltage so the output of the amplifier can approach zero. Feedback is applied from the output to the non-inverting input of U3 to stabilize the system. C16 provides extra drive to extend the bandwidth.

3. Current Limit

An opto-isolator in series with the drive transistors senses the output current and at a preset level trips the comparator/latch U4. This lights the limit LED and turns on Q4 shunting the output to ground and forcing current boost transistor Q1 to shut off. Pressing the "Reset" button sends a short pulse to Q6 which resets the latch. If overload conditions still exist the trip process immediately repeats. The level is set with a shunt resistor (R23) across the opto-isolator.

4. Output Monitor

The output is divided by a precision resistor network and buffered by U4. This signal is further divided and used for the digital readout option.

B. Troubleshooting

The PZ-70 is internally protected against most forms of abuse. Always check to be sure a suspected problem is not the result of a defective load or input condition. For instance, attempting to drive a capacitive load with square waves will cause continuous current limit due to the high current spikes caused even at fairly low voltages.

Certain precautions are necessary when working with the PZ-70 circuitry.

1. Never work on the PZ-70 alone.
2. Understand the schematic and always keep in mind that high voltage may be present where it is not expected due to component failure.
3. Wait at least 2 minutes after unplugging the PZ-70 before attempting to replace parts.
4. Be sure your test equipment (especially digital voltmeters) are rated for the voltages you expect to measure. We recommend a minimum of 1500 VDC.
5. Work slowly and if in doubt about anything, call the factory for assistance.

Standard signal tracing techniques may be used to isolate problems using the circuit description and schematic. Signals between U3 pin 7 and the output will look severely distorted as they are within the feedback loop. Low voltage operation may be checked at U3 pin 6. If this proves satisfactory then the problem is in the current limit or the output devices. Removing U2 will disable the current limit and allow a check of the output. Never change the value or circumvent F1. The following voltage checks may prove helpful. (All checks NO LOAD)

Input Signal	Gain	Bias	Location	Voltage	
				AC (p-p)	DC
0v	Full Clockwise	Full Counter-Clockwise	U3 pin 14	0	0
			8	0	0
			1	0	0
			5, 6	0	0
			Output	0	-4 to +2v
2v p-p	Full Clockwise	Midpoint	U3 pin 14	2	0
			8	3.5	0
			1	0	3.8
			5, 6	1.75	1.75
			Output	420	500

- Note:
1. All voltages $\pm 20\%$
 2. Voltages within the feedback loop will vary greatly and therefore are not included, however it should be noted that U3 pin 7 will always operate near the -15v level.
 3. Changing output devices may require selecting D20 such that the output does not exceed 1250v and does not distort signals below 1000v.

5. SPECIFICATIONS

Output Voltage:	0 - 1000 VDC
Output Current:	20 ma max.
Small Signal Bandwidth:	5 KHz
Slew Rate:	5 v/ μ sec
Input Impedance:	250 K
Maximum Input:	± 15 v
DC Linearity:	< 0.5%
Noise and Ripple:	< 20 mv RMS
Gain:	0 - 200, non-inverting
Stability (24 hours):	< 500 mv (after warm-up)
Regulation:	0.1% for 10% line regulation
Input connector:	BNC
Output connectors:	BNC and Viking Thorkom TKR-07
Output $\div$ 100 connector:	BNC
Power Consumption:	40 watts
Power Requirements:	110/220VAC ($\pm 10\%$) 50/60 Hz
Fuse:	1/2 Amp Slo-Blo for 110 VAC
Line Cord:	6' 3 wire standard U.L.
Dimensions:	4" H x 17" W x 12" D
Weight:	13 lbs.

FRONT PANEL

Power:	On/Off. Back-lighted for darkened lab operation
Gain:	3 $\frac{3}{4}$ turn pot, non-inverting, variable 0 to 200 (inverting operation optional)
Bias:	3 $\frac{3}{4}$ turn pot, variable 0 to +1000 volts
Limit:	LED to indicate overload condition
Reset:	Button to reset limit circuit after overload condition encountered
Range:	Two position switch for normal or low resistance load (0-500 volts or 0-1000 volts)
Digital readout (not shown):	Optional 3 $\frac{1}{2}$ digit LED display, 1 volt resolution

BACK PANEL (not shown)

Input:	BNC connector
Outputs:	BNC connector or Viking Thorkom TKR-07
Output $\div$ 100:	BNC connector to observe output on chart recorder or oscilloscope

CAPACITANCE OF BURLEIGH PZT ASSEMBLIES

PZT Assembly	Motion	Capacitance
RC Fabry-Perots dual PZT drive visible scanning elements	1.25 μ m/1000v	9nf/element
IR scanning elements	6 μ m/1000v	25nf/element
Alignment elements	1.75 μ m/500v	16nf/element
TL Series Tunable Etalons, visible 3 element PZT	2 μ m/1000v	2nf/element
TL Series Tunable Etalons, infrared 3 element PZT	6 μ m/1000v	6nf/element
PZ-81, PZ-91, PZT Aligner/Translators, 3 element	2 μ m/1000v	2nf/element
PZ-80, PZ-90 PZT Aligner/Translators, 3 element	6 μ m/1000v	6nf/element
PZ-30 PZT Pusher	5 μ m/1000v	9nf
PZ-40 PZT Pusher	15 μ m/1000v	28nf ✓
PZ-44 PZT Pusher	40 μ m/1000v	85nf

PERTINENT FORMULAE:

$$V = IR$$

$$P = IV$$

$$V = V_0 \sin (2\pi ft.)$$

$$dv/dt = V_0 2\pi f \cos (2\pi ft.)$$

$$dv/dt (\max) = V_0 2\pi f$$

For capacitive loads:

$$I = C dv/dt$$

$$I = CV_0 2\pi f \cos (2\pi ft.), \text{ sine wave output}$$

$$I_{\max} = CV_0 2\pi f, \text{ sine wave output}$$

$$I_{\text{RMS}} = 0.707 CV_0 2\pi f, \text{ sine wave output}$$

For resistive loads:

$$I = V_0 \sin (2\pi ft.) / R$$

$$I_{\max} = V_0 / R (\text{ sine wave output or DC})$$

$$I_{\text{RMS}} = 0.707 V_0 / R (\text{ sine wave output})$$

6. WARRANTY

The Burleigh PZ-70 is warranted against defects in material and workmanship for a period of one year after date of delivery and the return of Burleigh's warranty card. During the warranty period, Burleigh will repair or at its option, replace parts which prove to be defective when the instrument is returned prepaid to Burleigh Instruments, Inc. Before return of an instrument always call Burleigh for approval of the return. The warranty will not apply if the instrument has been damaged by accident, misuse, or as a result of modification by persons other than Burleigh personnel.

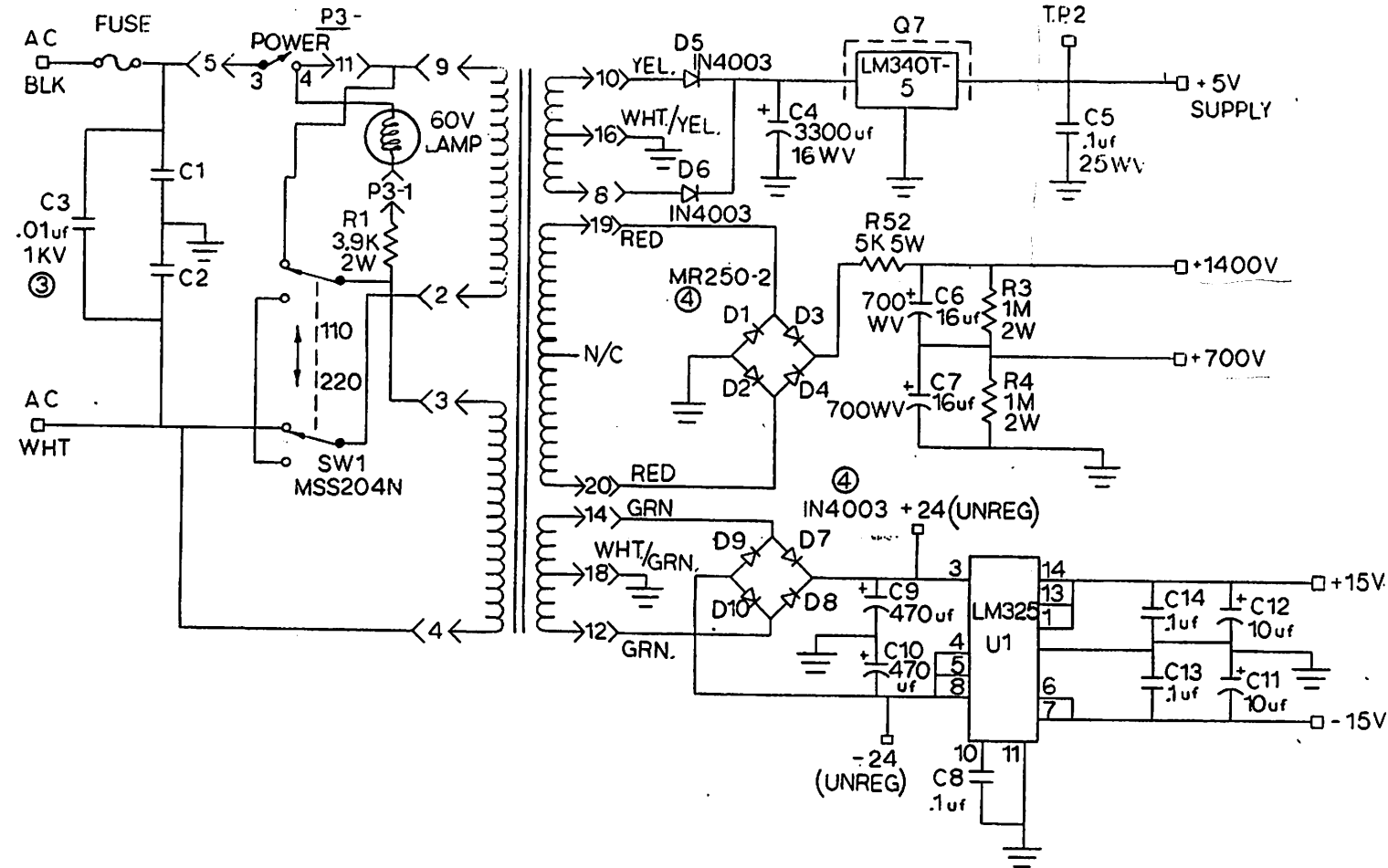
burleigh

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REV	DATE	DESCRIPTION	ECO #



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MAT'L:		UNLESS OTHERWISE SPECIFIED TOLERANCES	
CHEM FIN:		2 PLACE $\pm .010$	
		3 PLACE $\pm .005$	
		ANG $\pm$	
		SURF FIN	
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BURLEIGH INSTRUMENTS INC.

PROD: PZ-70

NAME: POWER SUPPLY

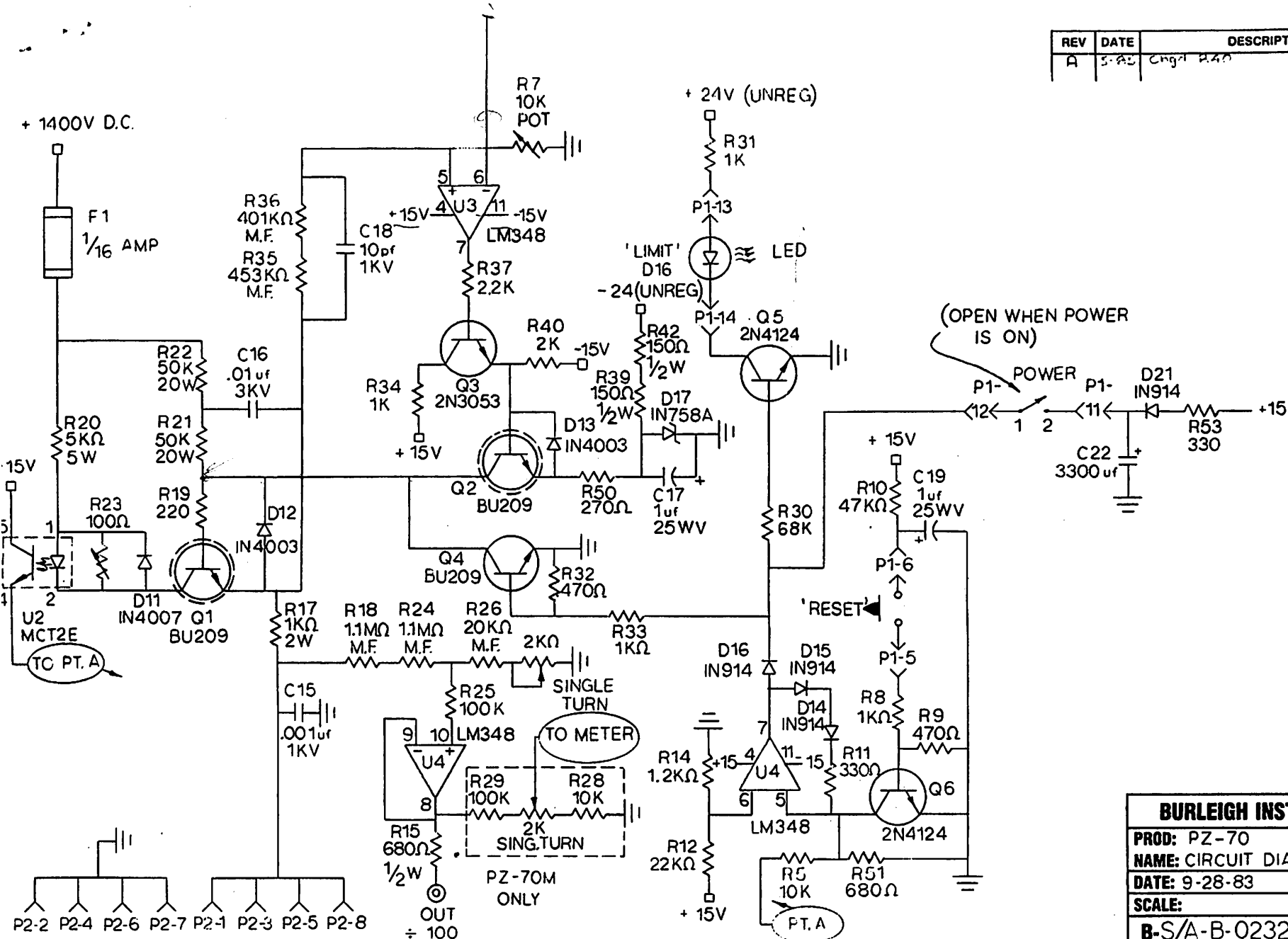
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DRWN: D.S.W.

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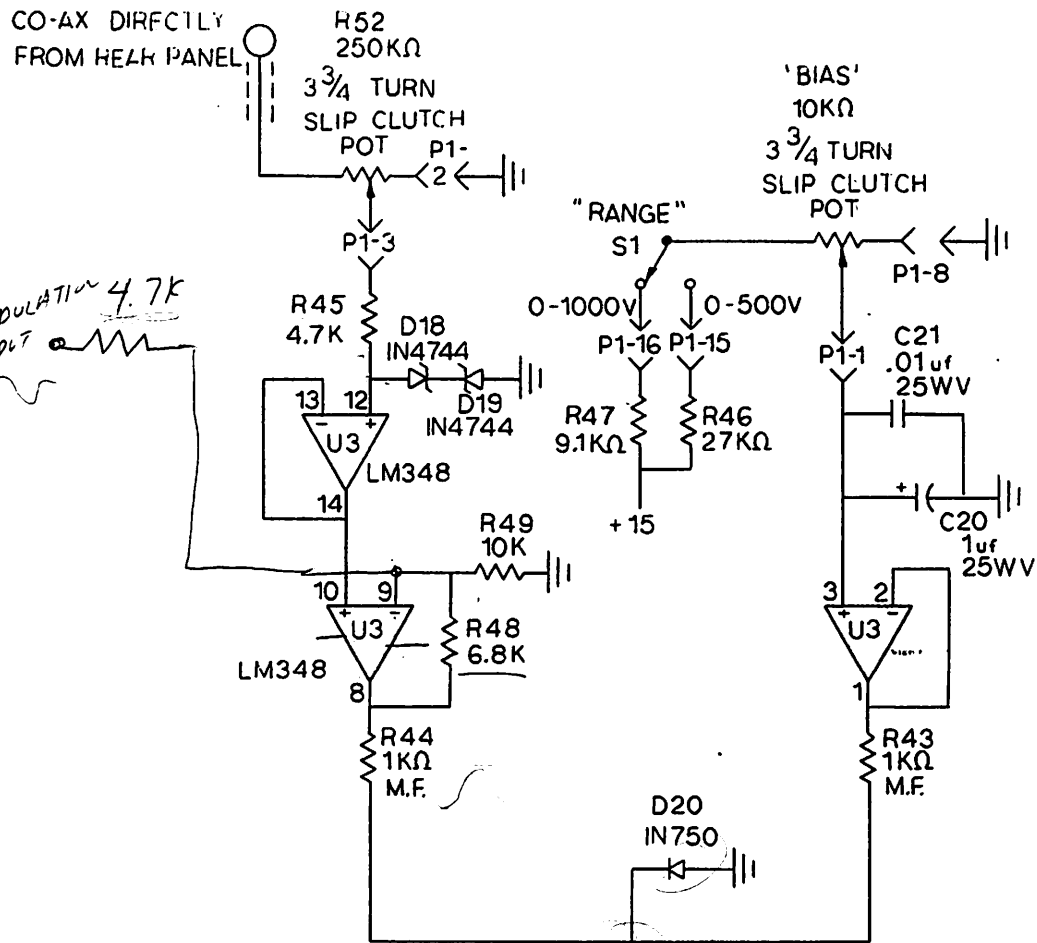
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REV	DATE	DESCRIPTION	ECO #
A	5-85	Chg'd P. 40	612



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PROD: PZ-70	
NAME: CIRCUIT DIAGRAM	
DATE: 9-28-83	DRWN: D.S.W.
SCALE:	CHKD: REV A
B-S/A-B-02322-01	
SHEET 1 OF 2	

REV	DATE	DESCRIPTION	ECO #



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		3 PLACE $\pm .005$		NAME: CIRCUIT DIAGRAM	
		ANG $\pm$		DATE: 9-28-83	DRWN: D.S.W.
		SURF FIN		SCALE:	CHKD:
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